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**OBJECTIVE MEASUREMENT OF CLINICAL COMPETENCIES
IN A
FAMILY PRACTICE RESIDENCY PROGRAM**

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A handwritten signature in black ink, reading "William J. Cairney". The signature is written in a cursive style with a large initial "W".

WILLIAM J. CAIRNEY, Ph.D.
Director of Medical Education:
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1. Original Air Force ISD Model
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OBJECTIVE MEASUREMENT OF CLINICAL COMPETENCIES IN A FAMILY PRACTICE RESIDENCY PROGRAM

ABSTRACT

The Instructional System(s) Development (ISD) model has been used extensively in the technical training environment for many years and over a wide range of cognitive levels. The Colorado Springs Osteopathic Foundation and Family Medicine Center has adopted the central features of ISD for its family practice residency program. ISD, along with embedded assessment strategies and longitudinal development of skills, provide a more objective measure of clinical competencies and effectively enable evaluation of process, synthesis, and critical thinking skills. ISD principles also can be adapted to an assessment system that extends beyond the residency program well into a graduate physician's professional career.

INTRODUCTION

The Colorado Springs Osteopathic Foundation (CSOF) and Family Medicine Center (FMC) has been the recipient of a series of three-year grants from the Health Resources and Services Administration to refine several features of its Family Practice Residency Program. A primary objective of the grant series has been to develop an objectives-based evaluation system that can be used to measure clinical competencies of residents. While several comprehensive written standards exist for family practice residencies, few, if any, really address the issue of a reliable scoring system to accompany published objectives. Most written standards, while strong in defining what graduating residents must know, do not define or propose assessment instruments that adequately measure process, synthesis, and critical thinking skills. Our challenge has been (and continues to be) to write a training system that addresses changing technologies, clinical methods and techniques, *and*, simultaneously incorporates an active redefinition and refinement of performance standards. This paper explains *our* approach to what we know is a common problem for everyone in medical education.

BACKGROUND

In order to meet these simultaneous programmatic goals, we evaluated several published standards for postgraduate medical education in family practice. We also examined various educational methodologies and strategies that seemed to provide a means to address the problem of a professional environment that is constantly changing. The CSOF/FMC family practice residency is based on clinical competencies as outlined in the *Basic Standards for Residency Training in Family Practice*, American Osteopathic Association and the American College of Osteopathic Family Physicians.¹ This document (referred to hereafter as the *Basic Standards*) outlines objectives and expectations of physicians providing comprehensive primary care for patients in an ambulatory setting (and, secondarily, for patients in a hospitalized setting). Each clinical specialty is addressed with competencies itemized according to three skill levels.

Basic Standards sets forth a core curriculum and divides to-be-acquired skills into the aforementioned three categories as follows (from *Basic Standards*, p.9):

CATEGORY I

- A. Concept *implies* (our emphasis) competency in evaluation and management in a majority of the cases.
- B. Skills *implies* (our emphasis) the ability to order, perform and interpret procedures without consultation in a majority of the cases.

CATEGORY II

- A. Concept *implies* (our emphasis) that consultation may be required for some part of the management in this area.
- B. Skills *implies* (our emphasis) that the physician may need assistance in performing and interpreting some of the procedures.

CATEGORY III

- A. Concept implies knowledge of the problem but not a full understanding and consultation would be required.
- B. Skills implies the need for referral to perform and interpret the procedures.

Each clinical specialty then is addressed with competencies itemized according to each of the three categories. While the educational objectives, concepts, and skills clearly and adequately outline the knowledge base required of residency program graduates, there are no objective, quantitative measures of success by which to assess true performance. Indeed, the only "measure" is the "acknowledgement" of a resident's ability, consistent with CATEGORY I competencies, to be able to "order, perform and interpret procedures without consultation in a majority of the cases." Interestingly enough, previous iterations of the *Basic Standards* document quantified what is now "majority" as "95%" of the cases.² We have tried to come up with a means of accomplishing such measurement while also accommodating technological progress and change.

ADOPTION OF INSTRUCTIONAL SYSTEM(S) DEVELOPMENT (ISD) SCHEMA

In attempting to meet the additional requirement of identifying a training system that incorporates *redefinition* and *refinement* of performance standards, we examined several educational systems and variations on the themes. Holding the greatest promise for our particular application is the Instructional System (or Systems) Development (ISD) system that has been used extensively in the technical training environment for many years. It has been used over a wide range of cognitive levels from basic technician-level training to educational programs at the college and graduate levels. It has been used extensively by the military and has reached a very high level of refinement in programs conducted for all levels at the USAF School of Aerospace Medicine, San Antonio, Texas, and by the 396th Medical Training Group, Sheppard Air Force Base, Texas. Programs based upon ISD at the USAF School of Aerospace Medicine include the Aerospace Medicine Primary Course (beginning course for flight surgeons), the Aerospace Nursing Course, Aeromedical Technician Training, Aerospace Physiology Course, the Aerospace Medicine Residency Program, and a variety of other courses and programs including short courses and longer fellowship programs in hyperbaric medicine. At the 396th Medical Training Group, ISD has been used successfully in an array of courses including the USAF Physician's Assistant Program. Thus, the fundamental concepts have been well tested.

A primary strength of ISD is its ability to assimilate new components over time and thus respond to changing conditions and novel educational environments. Tennyson outlines four distinct phases in the evolution of ISD.³ The first version of ISD stressed behavioral learning patterns and consisted of four elements: objectives, pretest, instruction, and posttest. As with all subsequent iterations, Phase I included an evaluation loop allowing for refinement of the specific educational system. With time, ISD incorporated elements of systems engineering and instructional technology as well as cognitive and behavioral psychology. These disciplines can be seen entering the subsequent phases of ISD.

Phase II of ISD retained its behavioral flavor but incorporated principles of systems theory and instructional technology. In Phase III, cognitive theory became prominent. Simulations were introduced for acquisition and assessment of cognitive skill levels, and interactive process was adopted to confer greater flexibility of application. Phase IV acknowledged and included technological advancements in artificial intelligence along with strategies for continuous evaluation.⁴ As a consequence, ISD has become an increasingly better system for Continuous Quality Improvement (CQI), a process to which the CSOF/FMC family medicine residency program is firmly committed.

The ISD model adopted by the CSOF/FMC residency program is an adaptation of the original model used for Air Force medical training. As with all ISD models, the original Air Force model was a self-refining loop that allowed for changes in instruction based on changes in system requirements. It contained five steps. This model is shown in Figure 1. The CSOF/FMC ISD model shown in Figure 2 is a seven-step variation defining the precise sequence of events required for residency training in this longitudinal, ambulatory clinic setting. The seven steps are as follows:

1. Establish Basic Requirements

What is it that we expect of our training program? What is it specifically being designed to accomplish? What requirements is it being designed to meet? The answer to these questions will result in the formation of general objectives and outcomes.

2. Establish Specific Tasks

How will those general objectives best be accomplished? What *specific* skills must the graduates possess in order to meet the overall goals? This exercise will result in a list of skills, long or short, depending on the specific goal.

3. Educational Program Tasks and Performance Standards

Educational program tasks must be established to address how best to meet the acquisition of each specific skill. These can be very detailed, especially if skills require procedural steps for their accomplishment. In addition, criteria need to be established for rating the performance of each of the skills. This assures uniformity in the competencies of each graduate and allows a certain accreditation or certification level for the program. It is this area that we will be addressing shortly and in more detail.

4. Formal Education Program

This is the formalization of the didactic session, laboratory experiences, skill practice experiences, evaluation and assessment methods, etc. that support acquisition of the desired competencies.

5. Program Graduates

Individuals are graduated with the required skills. They begin performing work responsibilities commensurate with their certified competencies.

6. Evaluation of Graduates

This can be accomplished by a variety of methods, including visitation of graduates as they perform in their respective work settings, interviews with supervisors and employers, self reviews, and peer reviews. Graduates are evaluated by how well they are able to apply the skills taught in the program.

7. Refinement and Redefinition of Performance Standards

Not only are graduates evaluated, but so is the very program itself. Are the requirements that drove the formation of the program still in existence...or have they changed? Will changing requirements drive changes in expected competencies? Have technological advancements rendered some of the original skills obsolete? Have technological advancements driven the requirement for new skills? In any case, do we need to establish new requirements? If so, then...

1. (Re)establish Basic Requirements

Outline new expectations and reinitiate the loop. Form new objectives and outcomes.

BEHAVIORAL OUTCOMES: STRENGTHS AND LIABILITIES

One of the greatest strengths of ISD is the requirement to state learning outcomes in behavioral terms. Any skill, no matter how minute or exacting, can be described in terms of what the student is expected to do. In technical training, especially, this ensures standardization and provides objective measurement of success. Once learning objectives are developed along with an assessment system that measures those objectives, evaluation can proceed according to clear criteria.

One of the greatest liabilities of this system is the *requirement to state learning objective in behavioral terms! Any skill, no matter how minute or exacting, must be described in terms of what the student is expected to do.* While standardization surely occurs, training manuals stating behaviorally worded outcomes can reach record length, even for "simple" technical training courses. This drawback appears not to bother the Air Force which has never been intimidated by paperwork requirements. Some of the technical training standards are monumental in length.

To illustrate this point, suppose we were to lift a section of the *Basic Standards* and compose behaviorally worded outcomes and indicators of learning success. We could display the educational objectives and the only suggested quantitative measures in the following way:

Adaptation from *Standards for Residency Training in Family Practice*, 1/97 pp. 26-27

GASTROENTEROLOGY

(Added material in boldface.)

Outcomes and Indicators of Success:

By the end of the in-service segment, residents will

- understand the clinical concepts and management of:
 - a. Non-ulcerative disorders
 - b. Constipation/diarrhea
 - c. Anal Fissure + Fistula – Perineal or Perianal Abscess
 - d. Proctitis, anal and rectal pain
 - e. Peptic Ulcer disease
 - f. Hemorrhoidal complaints
 - g. Hepatitis

They will demonstrate their understanding by:

Correctly evaluating and managing each disorder in a majority of the cases.

- perform competent diagnosis of:
 - a. Biliary Tract disease
 - b. Chronic Enteritis, Ulcerative Colitis, chronic disease

They will demonstrate their understanding by:

Correctly diagnosing each disorder in a majority of the cases.

- perform skills associated with:
 - a. Gastrointestinal history and exam
 - b. Proctoscopy

They will demonstrate their skills by:

Ordering, performing and interpreting procedures in a majority of the cases.

The awkwardness, redundancy, and subjectivity of this "objective" measure can be seen immediately, especially with no definition established for "majority" (51%? – We hope not!). Earlier versions of the *Basic Standards* called for certification of a 95% case management success rate. However, this was to be guaranteed for every itemized condition. For Category II and Category III competencies, no scorable or objective criteria are suggested.

ISD IN THE CSOF/FMC RESIDENCY – IMPLEMENTATION

Our Family Practice Residency faculty has made significant progress implementing several steps in the ISD-based model. In **Establishment of Basic Requirements**, we have set criteria for the graduate physician in three areas: The Physician as a Provider, the Physician as an Educator, and the Physician as an Administrator.

- As a **Provider**, the physician is to be proficient in the treatment of pediatric, adolescent, adult, and geriatric patients, providing for acute, chronic, and preventive care. Acute care skills include problem identification and differentiation, and patient stabilization. Chronic care skills include the management of longer term diseases. Preventive care includes proficiency in cancer screenings, diet and exercise education, and health education. Following from that...
- As an **Educator**, the physician is to be proficient at self-education, and in the education of peers and staff.
- As an **Administrator**, the physician must be familiar with systems that promote and guarantee on-going quality care on a cost-effective basis.

We also have completed step 2 by **Establishing Specific Tasks** which we have divided into three components. First, we have defined the specific skills required to meet the program objectives. Next, we have established clinical exercises to develop these skills. Finally, we have addressed the concept of critical case load raised in the *Basic Standards*.

Under the first of the basic requirements (The Physician as a **Provider**), we see the following as necessary in meeting the program objectives:

- Knowledge of the basic sciences;
 - Knowledge of medical/physiology/pathology
 - Knowledge of common disease states

- Understanding of clinical medicine – application of basic science to clinical presentations;
 - Ability to manage chronic illness
 - Ability to provide preventive care
- Diagnostic judgment – thorough evaluation of a patient problem;
 - Ability to order and interpret diagnostic tests
- Comprehensiveness of treatment plan – diagnostic evaluation
 - Ability to devise treatment plan
 - Ability to case manage
- Understanding of clinical procedures – recognizing indications/contraindications of diagnostic/therapeutic procedures;
 - Recognition of patient care protocols
- Technical Ability
 - Ability to perform diagnostic procedures
 - Ability to perform surgical procedures
- Critical decision making – prioritizing elements of an evaluation/treatment plan;
 - Ability to recognize medical emergencies
- Application of Osteopathic Principles – ability to apply osteopathic principles to the daily practice of Family Medicine;
- Utilization of behavioral skills and concepts – ability to utilize effective communication skills when working with patients;

Under the second of the basic requirements (The Physician as an **Educator**), we see the following:

- Interest in self-directed study – developing educational goals suited to meet one's educational needs;
 - Ability to use informational resources (texts, journals, databases, audiovisual, computer on-line services and tutorials, home study modules, etc.)
- Interaction with patient/family;
 - Ability to provide education and instruction, patient tutorials
- Quality of scientific research – performing research and presenting results in the form of peer lectures, publication of papers, and patient care summaries;
 - Journal Club presentations/participation; analysis of applicable research; conceptualization, development, and implementation or required (by the program) and self-initiated projects

Under the third of the basic requirements (The Physician as an **Administrator**), we see the following:

- Thoroughness of Charting
- Acceptance of administrative tasks
 - Ability to supervise employees and manage time effectively
- Leadership capabilities

In defining **Educational Program Tasks and Performance Standards**, we have:

- Established clinical exercises to develop these competencies, using "sentinel" or "hallmark" diseases that require integrative skills and the use of case simulations;
- Developed a scoring matrix, which (unlike ones we have seen that rate encyclopedic subspecialty details or itemize every last skill with accompanying redundant outcomes and indicators of success) represent performance standards that can be *generically* applied across the board. These performance standards include:
 - **Management of information and resource material**
 - This is not so much the rote memorization of facts, but the ability to identify and make effective use of a wide variety of resource materials to obtain required details and to incorporate appropriate factual material in course management. Graduates should show awareness of emerging technologies for information management, cataloging, and retrieval. The challenge is to know what information is out there and what information really makes a difference.
 - **Understanding pathophysiology**
 - Are there indicators that show clear understanding of the pathophysiological basis for disease?
 - **Justifying connections**
 - In assessing process, do residents make logical connections between basic biomedical theory and clinical situations?
 - **Critical thinking skills**
 - Does process lead to synthesis? Do information, understanding, and logical connection of theory with practice result in consistent, accurate, and focused diagnosis?

Each performance standard has a 1 – 5 point system and set criteria by which to award a rating along with word pictures describing points along the learning spectrum. Placing all of the foregoing into an evaluation form results in the two-page form shown in Figure 3.

Our in-house faculty has used this means of assessment very successfully. We have found the criteria to be clear for daily use. Evaluation results appear to be repeatable from one faculty member to another. We have given our evaluation forms (along with an explanation of the criteria) to our external preceptors for field testing. Our system has met with mixed results, due mostly (we feel) to unfamiliarity with ISD principles and a desire to "rate high" thus clouding true progress.

Future plans (consistent with ISD principles) call for preceptor workshops to explain the theory behind this evaluation system, refinement of point criteria, and establishment of new or better criteria. We are also developing an evaluation system for graduates based on similar criteria.

REFERENCES

1. *Basic Standards for Residency Training in Family Practice*. Jan 97 revision. American Osteopathic Association & American College of Osteopathic Family Physicians.
2. *Model Program for Two-Year Basic Standards for Residency Training in General Practice*. Adopted 3/91. American College of General Practitioners in Osteopathic Medicine and Surgery & American Osteopathic Association.
3. Tennyson RD, Michaels M: *Foundations of Educational Technology: Past Present and Future*. Englewood Cliffs, New Jersey: Educational Technology Publication, 1991.
4. *Instructional System Development*. AF Manual 36-2234. Department of the Air Force, Headquarters U.S. Air Force, Washington, D.C. 1993.

FIGURE 1

ORIGINAL AIR FORCE INSTRUCTIONAL SYSTEMS DEVELOPMENT MODEL

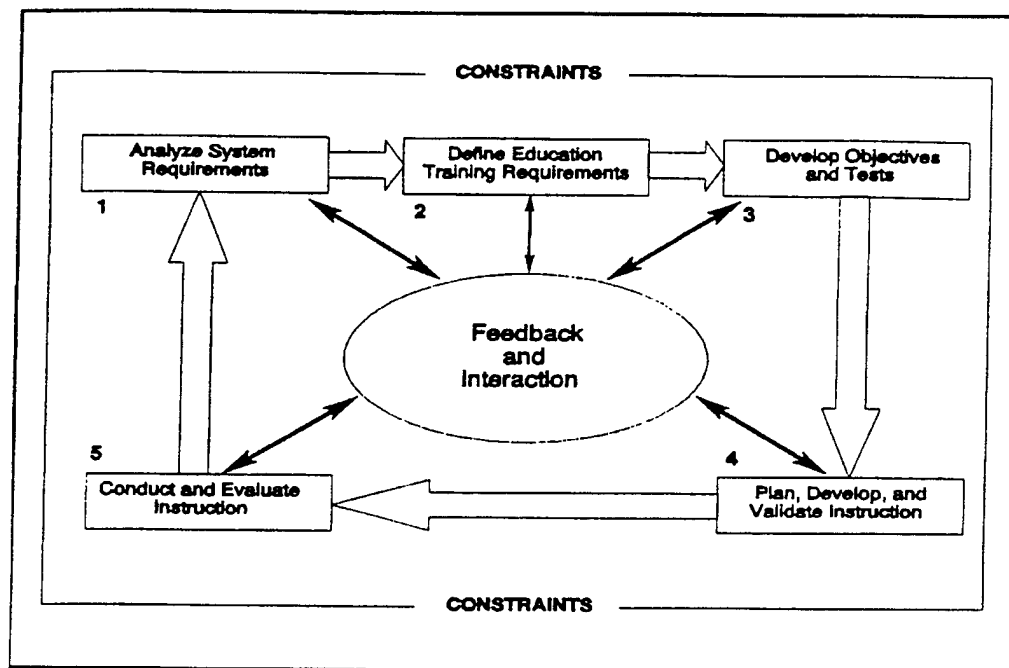


FIGURE 2.

COLORADO SPRINGS OSTEOPATHIC FOUNDATION & FAMILY MEDICINE CENTER INSTRUCTIONAL SYSTEMS DEVELOPMENT MODEL

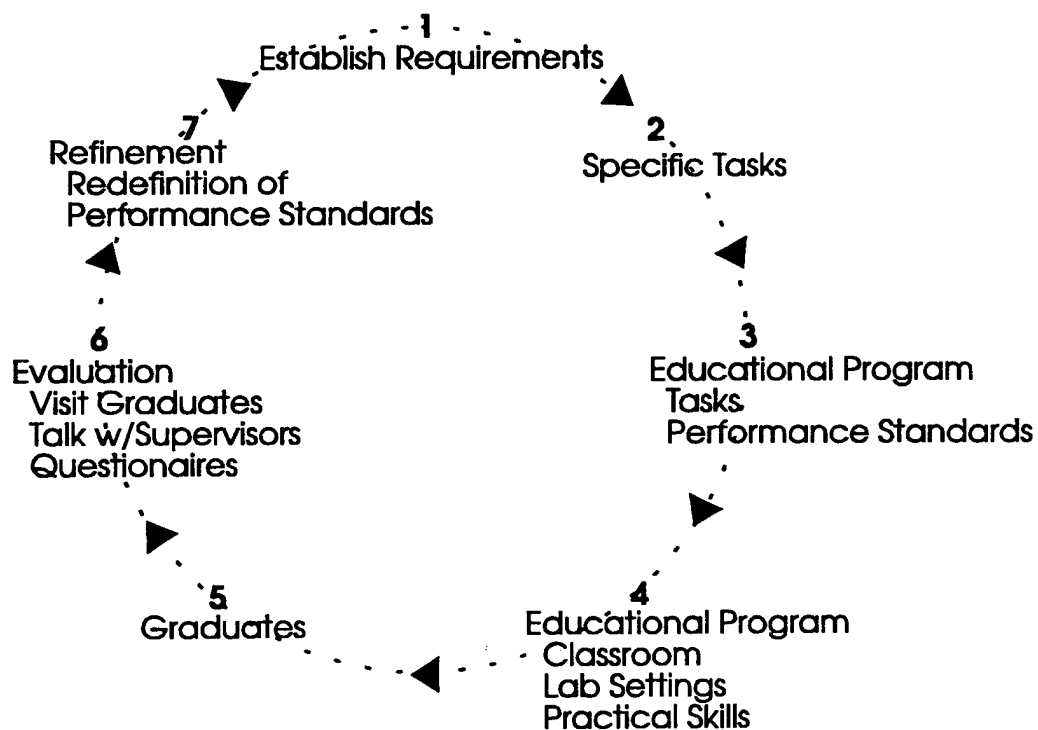


FIGURE 3.

EVALUATION of RESIDENT

RESIDENT _____

ROTATION _____

EVALUATOR _____

DATE _____

PGY	_____
QTR	_____
19	_____

Using the scales provided, rate on a scale of 1 to 5.

1. INFORMATION

1	2	3	4	5
Resident's use of resource material lacks specific detail and knowledge of where to find it; weak in concept vocabulary.		Resident uses resources in a more general way but without specifics.		Resident uses many details from multiple and appropriate sources to describe management of disorder. Strong use of concept vocabulary.

2. UNDERSTANDING PATHOPHYSIOLOGY

1	2	3	4	5
Resident generally weak in evidential pathophysiology.		Resident demonstrates general awareness of pathophysiology but presents few details.		Resident demonstrates clear understanding of pathophysiological basis of disorder.

3. JUSTIFYING CONNECTIONS

1	2	3	4	5
Resident's connections between theory and practical application generally unfocused.		Resident's connections between theory and actual situations apparent but superficial.		Resident shows multiple and logical connections between theory and actual situations.

4. CRITICAL THINKING SKILLS

1	2	3	4	5
Resident recalls some information but cannot transfer it to diagnostic.		Resident comprehends major concepts, applies concepts generally.		Resident synthesizes all available data into a working diagnosis.

THE PHYSICIAN AS PROVIDER

INFORMATION UNDERSTANDING PATHOPHYSIOLOGY JUSTIFYING CONNECTIONS CRITICAL THINKING SKILLS COMPOSITE SCORE

1. KNOWLEDGE OF BASIC SCIENCES Medical/physiology/pathology/common disease states					
2. UNDERSTANDING OF CLINICAL MEDICINE Ability to manage chronic illness/provide preventive care					
3. DIAGNOSTIC JUDGMENT Ability to order and interpret diagnostic tests					
4. COMPREHENSIVENESS OF TREATMENT PLAN Ability to devise treatment plan/case manage					
5. UNDERSTANDING OF CLINICAL PROCEDURES Recognition of patient care protocols					
6. TECHNICAL ABILITY Ability to perform diagnostic/surgical procedures					
7. CRITICAL DECISION MAKING Ability to recognize/treat medical emergencies					
8. APPLICATION OF OSTEOPATHIC PRINCIPLES					
9. UTILIZATION OF BEHAVIORAL SKILLS AND CONCEPTS					

THE PHYSICIAN AS EDUCATOR

10. INTEREST IN SELF-DIRECTED STUDY Ability to use medical resources (computer, library)					
11. INTERACTION WITH PATIENT/FAMILY Ability to provide pt education & instruction; pt tutorials					
12. QUALITY OF SCIENTIFIC RESEARCH Journal Club presentations/participation					

Please rate the remaining categories based on the following scale.

1	2	3	4	5
Skills generally weak.		Developing skills in this area; apparent progress.		Shows clear mastery of this skill.

THE PHYSICIAN AS ADMINISTRATOR

SCORE

COMMENTS

13. THOROUGHNESS OF CHARTING		
14. ACCEPTANCE OF ADMINISTRATIVE TASKS Ability to supervise employees/manage time efficiently		
15. LEADERSHIP CAPABILITIES		

PROFESSIONAL QUALITIES

16. INTERACTION WITH PHYSICIANS AND STAFF		
17. PROFESSIONAL DEMEANOR		
18. RESPONSE TO CONSTRUCTIVE CRITICISM		
19. ETHICAL STANDARDS		
20. DEDICATION TO MEDICINE		

ADDITIONAL COMMENTS/OBSERVATIONSThis image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

***RESIDENT SIGNATURE**

PRECEPTOR SIGNATURE

PROGRAM DIRECTOR SIGNATURE

*Signature of resident acknowledges receipt and review of evaluation, not necessarily agreement with content.